# TRANSVERSE-ROLLER-BELT SORTER WITH AUTOMATED GUIDE

## DESCRIPTION

### Background

[Para 1] The invention relates generally to power-driven conveyors and, more particularly, to sorting systems using roller-top conveyor belts to divert articles from one side or the other of a main conveyor.

[Para 2] In the tire industry, finished tires leave the inspection area in a mix of various types and sizes. Usually the tires are sorted automatically, using bar codes or colored line codes to designate type or size. Transported on a sorting conveyor, the tires are identified by a bar code or color code reader, or sometimes even by a human operator that recognizes the tire type and pushes the appropriate identification button. As soon as an identified tire passes the proper exit of the sorter conveyor for that type of tire, the tire is moved sideways at a 90° angle onto an exit conveyor that conveys the tire to the proper palletizing or storage station. Classical sorting systems use a complex set up of narrow belts and pop-up driven rollers to make the 90° diversion.

[Para 3] Several conventional sorting systems use transverse-roller-top belts in line with a main conveyor. Simple pneumatic or electric pushers push an identified tire off the side of the transverse-roller-top belt onto an exit conveyor. A disadvantage of this system is that it is difficult to transfer tires onto exit conveyors when they are positioned opposite each other across the main conveyor.

[Para 4] Thus, there is a need for a less complex sorting system for tires and other articles.

Summary

[Para 5] This need and other needs are satisfied by a sorting conveyor embodying features of the invention. The sorter comprises a sorting station that forms a segment of a conveying line conveying articles in a conveying direction. The sorting station comprises a roller-top conveyor belt that extends laterally in width from a first side to a second side. The belt travels in the conveying direction. Salient portions of rollers protrude outward from an outer surface of the belt to support a conveyed article. The rollers can be rotated to urge a conveyed article toward the first or second side of the belt. An elongated guide, which extends in length from a first end to a second end, is suspended above the outer surface of the belt. The guide is selectively positioned in a first position and in a second position. In the first position, the guide traverses the width of the belt to intercept a conveyed article and guide it atop the rollers off the first or second side of the belt. In the second position, the guide does not intercept a conveyed article and, instead, allows it to continue its advance in the conveying direction.

[Para 6] Another version of sorting conveyor also comprises a sorting station forming a segment of the conveying line conveying articles in a conveying direction. The sorting station comprises a roller-top conveyor belt and an elongated guide. The roller-top belt, which extends in width laterally from a first side to a second side, travels in the conveying direction. Rollers protrude outward of a horizontal upper surface of the belt to support conveyed articles. The rollers are arranged to rotate about axes generally in the conveying direction. The guide forms a generally vertical wall that extends in length from a first end to a second end. The guide is suspended above the

upper surface of the belt and is positionable in one or more blocking orientations and in one or more non-blocking orientations. In a blocking orientation, the guide crosses the belt from the first side to the second side to intercept a conveyed article and guide it atop the rollers off the first or second side of the belt. In a non-blocking orientation, the guide does not intercept a conveyed article but, instead, lets it continue to advance in the conveying direction.

[Para 7] Another version of sorting conveyor comprises a sorting station that forms a segment of a conveying line conveying articles in a conveying direction. The sorting station includes a roller-top conveyor belt that extends laterally from a first side to a second side. The belt, which travels in the conveying direction, has rollers that protrude outward of an upper surface of the belt to support a conveyed article. The rollers are arranged to rotate about axes generally in the conveying direction. The sorting station also includes an elongated guide forming a wall that extends in length from a first end to a second end above the upper surface of the belt. A drive in the sorting station has a moving element that is attached to the guide to adjust the orientation of the wall. The sorting conveyor also comprises a sensor disposed along the conveying line to sense a characteristic of a conveyed article at a position along the conveying line upstream of the sorting station. The sensor sends a signal indicative of the characteristic to a controller, which controls the drive to adjust the orientation of the wall as a function of the signal associated with a conveyed article.

[Para 8] According to another aspect of the invention, a sorting conveyor comprises a bidirectional sorting station that forms a segment of a conveying line conveying articles in a conveying direction. The sorting station includes a roller-top conveyor belt, first and second exit conveyors, and an elongated guide. The roller-top belt, which extends in width laterally from a first side to a second side travels in the conveying direction. The belt includes rollers having salient portions protruding outward from an outer surface of the

belt. The rollers, which support a conveyed article, can be rotated to urge a conveyed article toward the first or second side of the belt. The first and second exit conveyors abut the belt at its first and second sides. The elongated guide, which extends in length from a first end to a second end, is suspended above the outer surface of the belt. The guide is selectively positionable in various positions. In a first diverting position, the guide traverses the width of the belt with the first end of the guide at the first side of the belt and the second end of the guide at the second side of the belt and downstream of the first end. In this position, the guide intercepts a conveyed article and guides it atop the rollers off the second side of the belt and onto the second exit conveyor. In a second diverting position, the guide traverses the width of the roller-top belt with the first end of the guide at the second side of the belt and the second end of the guide at the first side of the belt and downstream of the first end. In this second diverting position, the guide intercepts a conveyed article and guides it atop the rollers off the first side of the belt onto the first exit conveyor. In a bypass position, the guide does not intercept a conveyed article; instead, the article is allowed to continue to advance in the conveying direction past the sorting station.

## Brief Description of the Drawings

[Para 9] These features and aspects of the invention, as well as its advantages, are better understood by referring to the following description, appended claims, and accompanying drawings, in which:

[Para 10] FIG. 1 is an isometric view of a portion of a conveying line with a sorting conveyor embodying features of the invention;

[Para 11] FIG. 2A is a top schematic representation of the sorting conveyor of FIG. 1 with a guide positioned to divert a tire to the left; FIG. 2B is a top schematic as in FIG. 2A with the guide positioned to allow a tire to

bypass the sorting station; and FIG. 2C is a top schematic as in FIG. 2A with the guide positioned to divert a tire to the right;

[Para 12] FIG. 3 is a side elevation schematic representation of the sorting conveyor of FIG. 1; and

[Para 13] FIG. 4A is a top schematic representation of another version of a sorting conveyor embodying a rotating guide; and FIG. 4B is a side elevation schematic representation of the sorting conveyor of FIG. 4A.

Detailed Description

[Para 14] One version of a sorting conveyor embodying features of the invention is shown in FIG. 1. The sorting conveyor comprises a sorting station 10 that forms a segment of a conveyor line, including upstream and downstream conveyors represented by arrows 12 and 13. The upstream conveyor transports articles, such as tires, in a conveying direction given by the direction of the arrows 12, 13 onto the top, outer surface 14 of a roller-top belt 16. The roller-top belt shown is a transverse-roller-top belt having a plurality of rollers 18 arranged to rotate on axes 20 generally in the conveying direction. In this way, the rollers can be made to rotate in the direction of two-headed arrow 22 to act as a freely rollable contact urging articles off a first or second side 24, 25 of the belt. In a preferred version, the rollers are generally cylindrical in shape with a salient portion protruding outward of the upper article-conveying surface. The preferred rollers have central bores admitting an axle whose ends are retained in the body of the belt. The rollers are retained in cavities in the belt by the axles. Unless the articles receive a push toward one side or the other, the rollers do not rotate. An example of such a belt is an Intralox Series 400 Transverse Roller-Top belt manufactured and sold by Intralox, L.L.C., Harahan, Louisiana, USA. The Intralox belt is a modular plastic conveyor belt constructed of rows of modules interconnected

typically in a bricklay pattern by hinge pins through a lateral passageway formed by the aligned openings in interleaved hinge eyes at the leading and trailing ends of the belt rows. Alternatively, other types of roller-top belts with rollers that can rotate to impart a rolling action conducive to sidewise transfer of articles off the sides of the belt can be used. Examples include roller-top flat rubber or fabric belts and metal roller-top belts or chains.

[Para 15] The roller-top belt 16 is looped around an idler sprocket set 26 and a drive sprocket set 27. The idler sprocket set is mounted on an idler shaft 28 rotatably supported at each end by bearings (not shown) mounted in the conveyor frame 31. The drive sprocket set is mounted on a drive shaft 29 coupled to a motor 30 via a bearing block 32 secured to the conveyor frame. Teeth on the sprockets engage drive structure in the inner side of the belt. In this way, the motor drives the belt to advance its outer conveying surface toward the downstream conveyor 13.

[Para 16] The roller-top conveyor belt is flanked on opposite sides by exit conveyors 34, 35. The exit conveyors shown in this example are conventional gravity-advance roller conveyors. The exit conveyors include a downwardly sloping frame supporting a plurality of consecutive rolls 36 that are free to rotate about their axes to discharge articles in the direction of arrows 38 and 39. A guide 40 is suspended above the outer conveying surface of the roller-top belt. The guide traverses the width of the belt from the first side to the second side. Opposite first and second ends 42, 43 of the guide are attached to arms 44, 45. The guide shown includes rollers 46 that protrude beyond both sides of the guide. The rollers preferably rotate about generally vertical axes to provide a low-friction sliding surface to articles conveyed on the generally horizontal roller-top belt. The guide may be realized in many ways. One way is as an Intralox Series 900 Roller Top belt. The guide forms a generally vertical wall that can intercept articles advancing along the conveyor line.

[Para 17] As better illustrated in FIGS. 2A-2C, the ends of the guide are attached to the arms 44, 45 of moving elements 46, 47 of linear actuators or drivers 48, 49. The moving elements may be pneumatically, hydraulically, or electromagnetically driven or driven by a motor and gear such as a lead screw. The linear drives are positioned in an upstream-downstream relationship traversing the roller-top belt. The linear drives define a track traversing the belt from the first side to the second side. The arms translate laterally along the tracks across the belt to position the ends of the guide on one side of the belt or the other.

[Para 18] In Fig. 2A, for instance, a conveyed article, such as a tire 50, is diverted to the left at the sorting station. The upstream end 43 of the guide is positioned at the right side of the roller-top belt 16 in the figure. The downstream end 44 is positioned at the left side. The guide 40 traverses the roller-top belt and intercepts the tire. The rollers on the roller-top belt and in the guide cause the tire to move sidewise toward the left exit conveyor 34. Once the tire 50 has been intercepted, the guide is ready to be moved into another position. In this example, the next tire 50′ is selected to pass on through the sorting station toward the downstream conveyor. The upstream end 43 of the guide is driven to the left side of the roller-top belt, as indicated by arrow 52. The guide is then oriented along the left side of the belt as shown in FIG. 2B. In this position, the second tire 50′ passes through as the first tire 50 continues its left exit. Of course, the bypass position could have been achieved by positioning the guide at the right side of the roller-top belt by moving the downstream end to the right. But this movement does not provide the added benefit of pushing the first tire 50 toward its intended exit. In FIG. 2C, the downstream end 44 of the guide is moved to the right side, as indicated by arrow 54, as soon as the second tire clears the sorting station. Now the guide traverses the roller-top belt along an angle relative to the conveying direction that mirrors the angle of the guide for diverting articles to the left. In this orientation, the guide diverts the third tire 50″ to the right-side exit conveyor. Thus, by shuttling the two ends of the guide across the

roller-top belt at upstream and downstream locations a bidirectional sorter with low-friction sideward translation is achieved.

[Para 19] Because the guide has to span a greater distance when blocking the conveying path, as in FIGS. 2A and 2C, than it does when in the non-blocking position of FIG. 2B, the guide preferably has an automatically adjustable length. One or more elastic panels, such as end panels 56 (FIGS. 1 and 3), connected between each arm 44, 45 and the nearest end of the guide, allows the guide to stretch into its expanded length for blocking and retract to its relaxed length for bypassing.

[Para 20] Another version of sorting conveyor is represented by FIGS. 4A and 4B. This version differs from the conveyor described previously in that the guide 40 pivots about a vertical axis 58 along a pivot shaft 60 attached generally midway between the ends 43, 44 of the guide. This positions the pivot point at about the center line of the roller-top belt 16. As shown in FIG. 4A, the guide assumes a first position to divert articles to the left into the left exit conveyor 34. The guide is rotated by a motor 61 coupled to the shaft about 90° into the mirror-image orientation 40′ to divert articles to the right exit discharge conveyor 35. The bypass position 40" is achieved by a lift mechanism, represented by arrows 62, that selectively raises and lowers the guide into and out of a blocking position over the roller-top belt. The lift mechanism can be motor-driven or hydraulically, pneumatically or electromagnetically actuated.

[Para 21] The rotation motor 61 and the lift 62 are controlled over control lines or channels 64 from a controller 66, such as a programmable logic controller, general-purpose computer, or any other intelligent controller. The controller also processes sensor signals over a signal line 68 from one or more sensors 70. Each sensor detects a specific characteristic of a conveyed article upstream of the sorting station. Examples of characteristics that may

be sensed include proximity to the sorting station, tire size, tire model, or the like. Typical sensors include bar code readers, color bar readers, RFID tag readers, proximity switches, and optical sensors, for example.

[Para 22] Although the invention has been described in detail with respect to a few exemplary versions, other versions are possible. For example, the lift mechanism can be used with the linear drives as well as with the rotational drive to achieve the bypass position. As another example, a unidirectional sorter can be made by using a single linear drive with one end of the guide attached to the moving element of the linear drive and the other end stationarily, but pivotally, attached at one side of the roller-top belt. And, as yet another example, the guide can be in the form of a swinging gate extendable across the roller-top belt and rotatable about a vertical axis at one side of the belt to realize a bidirectional sorter that diverts conveyed articles at locations on opposite ends of the belt, but offset in the conveying direction. So, as these few examples suggest, the scope of the invention is not meant to be limited to the specific features of the preferred version described in detail.